To balance people's interaction with the environment to protect human health and ecosystem integrity.

Drinking Water Compliance Report 2002

April 1, 2001 to March 31, 2002

EPB 198

Saskatchewan Environment

Environmental Protection Branch

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EXECUTIVE SUMMARY

This report provides an overview of compliance with provincial legislative and regulatory[(1)] requirements, and with Saskatchewan's Municipal Drinking Water Quality Objectives for the 2001/2002 fiscal year. Saskatchewan did not have legislated drinking water quality standards during the 2001/02 fiscal year, however, standards were introduced in December 2002. During the period to which this report applies the province used a risk management approach in cases where analytical results of drinking water sampling exceed Municipal Drinking Water Quality Objectives.

Environmental Protection Branch (EPB) reviewed the compliance of Saskatchewan's water system owners and operators under Saskatchewan Environment's (SE) legislated jurisdiction with drinking water quality monitoring requirements for the fiscal period 2001/2002. Compliance with sampling and with drinking water quality objectives is also compared to an earlier 2000/2001 Drinking Water Compliance Report and is summarized as follows :

Turbidity

Eighty-two per cent of the turbidity analysis results submitted by municipal water treatment facilities complied with the drinking water quality objective of 1 NTU (nephelometric turbidity units), however, this only represents a 63 per cent facility compliance rate during the 2001/2002 fiscal year. In comparison, 79 per cent of municipal turbidity results complied with the turbidity objective of 1 NTU, with a 58 per cent facility compliance rate during the 2000/2001 fiscal period. Based on submission records to date it is likely that less than two thirds of facilities had the required testing equipment to monitor this parameter. Information is not available on the current status of municipal owned turbidity monitoring equipment for this parameter.

Free Chlorine

During the 2001/2002 fiscal period, 96 per cent of regulated water treatment facilities complied with the testing requirement, and 87 per cent of the samples submitted met the minimum free chlorine residual required by regulation. In comparison, during the 2000/2001 fiscal year, 89 per cent of municipalities complied with this testing requirement, and 85 per cent of the samples submitted met the minimum free chlorine residuals required by regulation.

Total Chlorine

During the 2001/2002 fiscal period, 94 per cent of regulated water treatment facilities complied with the testing requirement, and 79 per cent of the samples submitted met the minimum total chlorine residual required by regulation. In comparison, during the 2000/2001 fiscal year, 89 per cent of municipalities complied with testing requirement, and 73.4 per cent of the samples submitted met the minimum total chlorine residuals required by regulation.

Microbiological

Regular Samples:

During the 2001/2002 fiscal year, 91 per cent of the regular bacteriological samples required from waterworks licensed by SE were submitted; 47 per cent of those waterworks which submitted samples consistently met bacteriological objectives. Less than 17 per cent of the facilities which submitted samples had more than 10 per cent of their samples which did not meet Municipal Drinking Water Quality Objectives.

During the 2000/2001 fiscal year, 90.1 per cent of the regular bacteriological samples required from waterworks licensed by SE were submitted; 32 per cent of those waterworks which submitted samples met bacteriological objectives. Over 29 per cent of the facilities which submitted samples had more than 10 per cent of their samples which did not meet Municipal Drinking Water Quality Objectives.

Repeat Samples:
During the 2001/2002 fiscal period, 98.2 per cent of the required repeat samples were submitted by SE licenced waterworks; 85.6 per cent of the results met objectives. In the 2000/2001 fiscal year, 89 per cent of the required repeat samples were submitted by municipalities; 77.3 per cent of the results met objectives.

Special Samples:
During the 2001/2002 fiscal year, **235** per cent of the required special samples were submitted by SE licenced waterworks; 83.4 per cent of the results met objectives. In the 2000/2001 fiscal period, **135** per cent of the required special samples were submitted by municipalities; 73.9 per cent of the results met objectives.

Trihalomethanes (THMs)
For the 2001/2002 fiscal year 91.8 per cent (157 out of 171) of SE licenced waterworks submitted at least some of the required THM samples; 105 out of 157 municipalities (67 per cent) submitted all of the required seasonal samples; 66 out of 157 municipalities met the provincial quality objective of less than 100 micrograms per litre (ug/L) for THMs.

In the 2000/2001 fiscal year 79 per cent (136 out of 171) of SE licenced waterworks submitted at least some of the required THM samples; 118 out of 136 municipalities (84 per cent) submitted all of the required seasonal samples; 63 out of 136 municipalities met the provincial quality objective of less than 100 micrograms per litre (ug/L) for THMs.

Health and Toxicity Related Chemicals
During the 2001/2002 fiscal year, **88** per cent of SE licenced waterworks submitted health and toxicity samples; 97 per cent of these waterworks met the drinking water quality objectives for health and toxicity related chemicals. In comparison, **30** per cent of municipalities submitted samples; 95 per cent of these municipalities met the drinking water quality objectives for health and toxicity related chemicals during the 2000/2001 fiscal year.

Pesticides
During the 2001/2002 fiscal year, **73** per cent of municipalities complied with the pesticide sampling requirements and all submitted samples met provincial objectives. In comparison, **54** per cent of municipalities complied with the pesticide sampling requirement during the 2000/2001 fiscal year and all submitted samples met provincial objectives.

Fluoride

During the 2001/2002 fiscal year 60 licensed water works either artificially fluoridated or had naturally occurring fluoride in their drinking water. Three communities submitted samples that indicated the MAC of 1.5 mg/l had been exceeded due to naturally occurring levels in their well water source. In comparison during the 2000/2001 fiscal year 87 communities either artificially fluoridated or had naturally occurring fluoride in their drinking water and the same three communities submitted samples that indicated the MAC of 1.5 mg/l had been exceeded due to naturally occurring levels in their well water source.

Total Dissolved Solids (TDS)

During the 2001/2002 fiscal year, **53** per cent of SE licenced waterworks submitted the required TDS samples; 67 per cent of these facilities met the provincial objective for TDS. In the 2000/2001 fiscal year, **35** per cent of municipalities submitted the required samples; 76 per cent of the samples submitted by these facilities met the provincial objective for TDS.

Operator Certification

On July 14, 2000, *amendments to The Water Pollution Control and Waterworks Regulations* (WPCWR), were enacted pursuant to section 38(1) of *The Environmental Management and Protection Act*. These amendments established an Operator Certification Board and empowered the Board to administer the Operator Certification Program. Within five (5) years of the date when *The Water Pollution Control and Waterworks Regulations, 2000* came into force, all regulated water and wastewater treatment facilities in the Province of Saskatchewan are required to have an appropriately certified operator to supervise the operation and maintenance of these works.

At the end of fiscal year 2001/2002 there were approximately 1,650 municipal operators on the operator database$_{(12)}$. Of these, 302 operators were certified in the **mandatory** operator certification program; this is a participation rate of 18.3 per cent.

By 2005 all waterworks licenced by Saskatchewan Environment will require to have at least one operator certified to operate the class of facility being operated. Based on the data available at the end of fiscal year 2001/2002, 145 facilities have at least one such operator which represents a 26.7% achievement towards the 2005 target for municipal waterworks.

1.0 Regulation of Works

1.1 Legislation and Mandate

SE's mandate for regulating the treatment and distribution of potable water comes from the *Environmental Management and Protection Act*, 1990 (EMPA)[2]. EMPA refers to the protection of the environment, and also to the protection of **public health**. The EMPA, (2002) was amended in July 2002 and proclaimed on Oct. 1, 2002. This report addresses the requirements of the Act and regulations in effect during the 2001/2002 fiscal year.

EMPA (1990) defines waterworks in this way: "Waterworks means any works for the supply, collection, treatment, storage or distribution of water for potable use or for delivery to residential property." (NOTE: "potable water" is defined in the Water Pollution Control and Waterworks Regulations as "water that is approved for human consumption".)

Pertinent sections of EMPA (1990) include:

Section 38(1) "The Lieutenant Governor in Council may make regulations:

(e) prescribing standards and authorizing the minister to prescribe standards for the design, construction, installation, alteration, extension, operation and monitoring of industrial effluent works, sewage works, and waterworks where those standards are required for the protection of the environment or the public health;

(f) respecting the training and qualifications of operators of industrial effluent works, waterworks and sewage works;"

These provisions provide the authority for SE to regulate all municipal water systems, and all private and government water systems utilizing capacities greater than 18 cubic metres per day.

The scope of this report includes a data evaluation for selected drinking water parameters at municipal, private and/or government water systems regulated by SE, for the period of April 1, 2001 to March 31, 2002 inclusive. Small private and government works with capacities of less than 18 cubic metres per day are regulated by Saskatchewan Health, and are therefore not included in this evaluation.

SE publishes several drinking water related materials, including: *Municipal Drinking Water Quality Objectives*[3], *A Guide to Waterworks Design*[4], *Municipal Drinking Water Quality Monitoring Guidelines*[5], *Surface Water Quality Objectives*[6], *Water/Wastewater Facilities - Facility Classification and Operator Certification*[7], *Turbidity Measurement*[8], *Guidelines for Chlorine Gas Use in Water and Wastewater Treatment*[9], *Reservoir Management*[10], and *A Guide to Aquatic Nuisances and Their Control*[11].

1.2 Number and Classification of Works Regulated

The breakdown of the province's water treatment and distribution works into their classifications are shown in Tables 1-1 and 1-2 respectively. Class 1 is the simplest, with Class 4 being the most complex. Information is from SE's WINDAT database[12].

Table 1-1 - Water Treatment Works

	WT-1*	WT-2	WT-3	WT-4
Municipal	370	129	15	4
Private	11	1	0	0
Government	12	3	0	0
Total:	393	133	15	4

Table 1-2 - Water Distribution Works

	WD-1**	WD-2	WD-3	WD-4
Municipal	505	36	5	2
Private	5	0	0	0
Government	7	0	0	0
Total:	517	36	5	2

* WT - Water Treatment

** WD - Water Distribution

In fiscal year 2001/2002 Saskatchewan had 517 municipal, 12 private and 15 government water treatment works falling under SE's legislation, for a total of 544 regulated water treatment works. An additional 49 municipal, private and government waterworks are classified as distribution only as they are receiving water from a licensed water treatment facility for a total of 593 regulated waterworks[12]. Small water systems, as identified in Table 8-1, are included in the counts for WT-1(Table 1-1) and WD-1(Table 1-2).

2.0 Microbiological

2.1 General Introduction

To protect the health and safety of Saskatchewan consumers, SE requires the owners and operators of water systems to regularly test for indicator bacteria in treated drinking water.

These indicator bacteria are total coliforms and fecal coliforms. During the total coliform test, the growth of background bacteria sometimes masks or suppresses the growth of coliforms. High levels of background bacteria should be absent in properly treated and safe drinking water. Therefore background bacteria are also monitored and included in SE's follow up system for bacterial contamination. SE does not require routine monitoring for general bacterial populations in drinking water, such as heterotrophic bacteria.

Saskatchewan's "Maximum Acceptable Concentrations" (MACs) for bacteria in drinking water are:

Total Coliforms:	Less than 1 organism per 100 mL of sample.
Fecal Coliforms:	Less than 1 organism per 100 mL of sample.
Background Bacteria:	Less than 200 organisms per 100 mL of sample.
Heterotrophic Bacteria:	Less than 50,000 organisms per 100 mL of sample.

Provincial bacteriological sample submission guidelines[5] are shown in Table 2-1.

Table 2-1 - Bacteriological Sampling Guidelines

POPULATION	GROUNDWATER SOURCE	SURFACE WATER AND BLENDED SOURCE
0 - 100	1 per 4 weeks	1 per 2 weeks
101 - 500	1 per 2 weeks	1 per week
501 - 5,000	1 per week	1 per week
5,001 - 100,000	1 per 2,000 population per 4 weeks	1 per 1,000 population per 4 weeks
Greater Than 100,000	1 per 4,000 population per 4 weeks	1 per 3,000 population per 4 weeks

2.2 Turbidity

Turbidity is an indirect measure of particles in drinking water. These particles may harbour disease causing bacteria or protozoa, they may add to cloudiness or impart colour, they may result in the production of disinfection byproducts, or they may interfere with disinfection efficiency in water treatment.

Turbidity is an important process control parameter, especially in surface water treatment.

Table 2-2 outlines monitoring guidelines for turbidity[5].

Table 2-2 - Turbidity Monitoring Guidelines

POPULATION	GROUNDWATER SOURCE	SURFACE WATER AND BLENDED SOURCE
0 - 100	None	1 per day
101 - 500	None	1 per day
501 - 5,000	None	1 per day
5,001 - 100,000	1 per day	Continuous
Greater than 100,000	Continuous	Continuous

During the 2001/2002 fiscal year, SE did not require municipalities to submit routine turbidity monitoring results, however, on-site monitoring for turbidity and record keeping is required for those works identified in Table 2-2. These records are checked during site inspections by SE's Environmental Project Officers.

Because of the potential health and safety implications of drinking water containing high turbidity, Saskatchewan has adopted the Canadian guideline[14] for turbidity. The MAC in effect during the 2001/2002 fiscal year for turbidity in drinking water was 1.0 NTU (nephelometric turbidity units).

The Aesthetic Objective (AO) for turbidity is 5.0 NTU. At this turbidity level the cloudiness of a water sample becomes visually apparent. A turbidity of 5 NTU may be acceptable if the water system owner can demonstrate that this higher turbidity does not interfere with disinfection of the drinking water. SE acknowledges that the turbidity MAC of 1.0 NTU may occasionally be exceeded in the distribution system, and that minor, infrequent excursions do not necessarily compromise drinking water safety. However, unusual spikes or large changes in normal turbidity levels may indicate operational or source water problems that should be investigated.

Figure 2-1 - Turbidity Compliance Chart

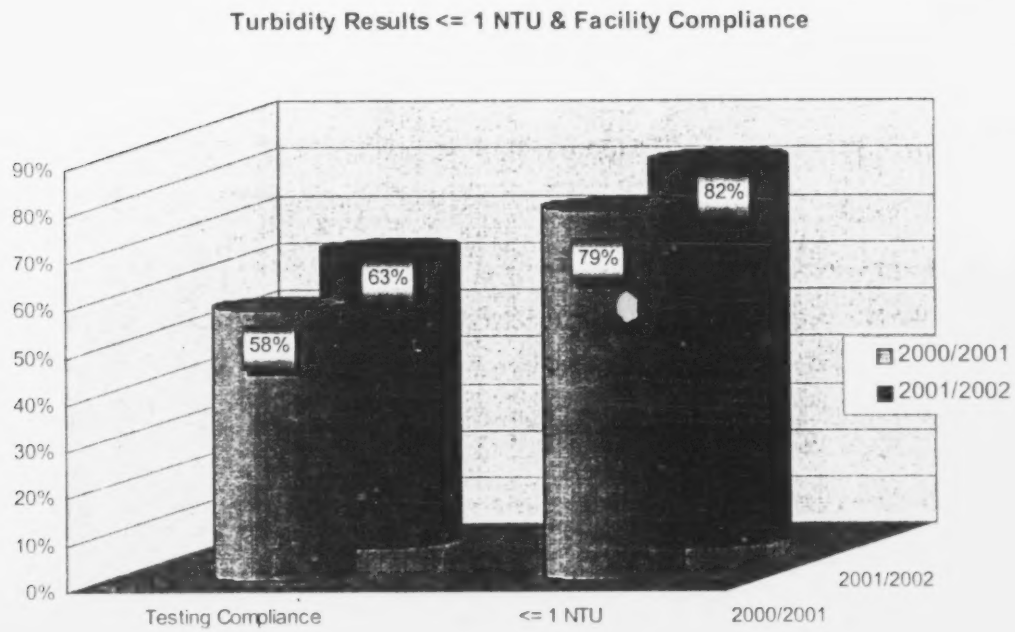


Figure 2-1 shows a compliance comparison chart for turbidity sampling less than the MAC of one NTU and the percentage of required facilities testing and submitting samples for the 2002/2001 fiscal year versus the 2009/2001 fiscal year, based on testing by system owners(15).

Eighty-two per cent of the turbidity analysis results complied with the drinking water quality objective of one NTU, which represents a 63 per cent facility compliance rate during the 2001/2002 fiscal year. In comparison, seventy-nine per cent of results complied with the turbidity objective of one NTU, with a 58 per cent facility compliance rate during the 2000/2001 fiscal period.

The data for the Figure 2-1 consists of data reported by the system owners on their bacteriological sample submission forms. Ground water, surface water and blended systems are included.

The range of turbidity results tested by all agencies(15) in 2001/2002 (municipal, private and government owners) were:

Turbidity Range (NTUs)	Samples	% Samples	Systems
0 - 1	4,977	82.3 %	153
1 - 2	694	11.5 %	76
2 - 3	194	3.2 %	40
3 - 4	67	1.1 %	22
4 - 5	48	0.8 %	17
> 5	66	1.1 %	16
	6,046	100 %	170

Of the 170 facilities reporting turbidity monitoring data in 2001/2002, 153 facilities reported 4,977 of the 6,046 turbidity results to be less than the MAC, for a compliance rate of 82.3 per cent.

The range of turbidity results tested by all agencies(15) in 2000/2001 were:

Turbidity Range (NTUs)	Samples	% Samples	Systems
0 - 1	4,068	79.1 %	145
1 - 2	666	13.0 %	70
2 - 3	237	4.6 %	45
3 - 4	88	1.7 %	23
4 - 5	28	0.5 %	13
> 5	54	1.1 %	16
	5,141	100 %	153

Of the 153 facilities reporting turbidity monitoring data in 2000/2001, 145 facilities reported 4,068 of the 5,141 turbidity results to be less than the MAC of 1 NTU for a compliance rate of 79.1 per cent.

2.3 Chlorine Residuals

Municipalities must provide multiple barriers to waterborne disease in their waterworks systems to ensure public health and safety. These barriers include protection of their raw water supplies (watersheds, reservoirs and well fields); employing treatment processes such as coagulation, sedimentation, filtration and disinfection; cleaning of storage and distribution systems; and prevention of cross connections in their distribution systems. **Disinfection by chlorination is one of the key barriers to the spread of waterborne disease.**

Sections 23(3) and (4) of the WPCWR 2000[1] require municipalities to continuously disinfect their drinking water. These regulations also stipulate that the owner or operator of a waterworks maintain:

(a) a free chlorine residual of not less than 0.1 milligrams per litre in the water entering a distribution system; and

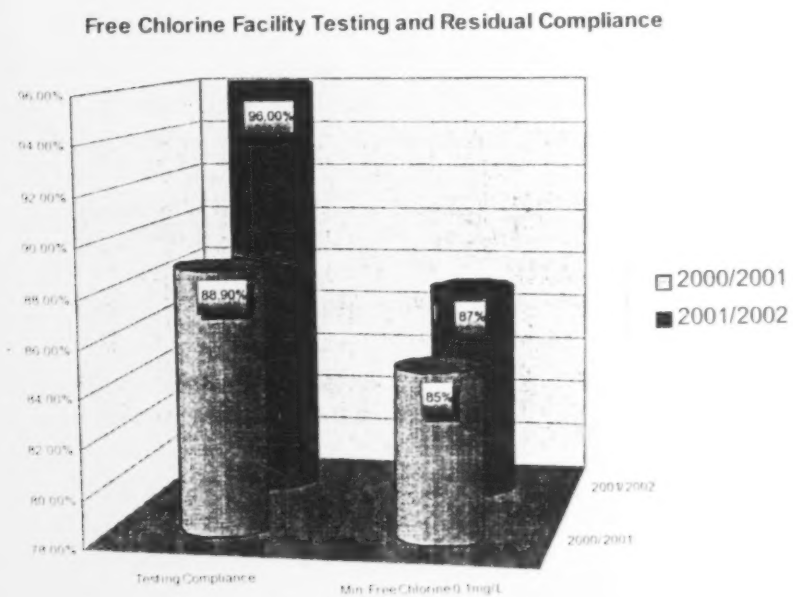
(b) a total chlorine residual of not less than 0.5 milligrams per litre or a free chlorine residual of not less than 0.1 milligrams per litre in the water throughout the distribution system.

Section 25(6)(a) of the WPCWR 2000[1] requires the owner or operator of a waterworks to take daily chlorine residual tests to confirm if the required residuals are being achieved. SE does not require the owners and operators of licensed works to routinely submit these test results, although they are checked by SE during site inspections. Testing of free and total chlorine residuals at the treatment plants and within the distribution systems is also conducted by SE during inspections. SE encourages municipalities to record chlorine residuals on bacteriological sample submission forms.

The guideline for minimum monthly chlorine monitoring[5] is:

- for free chlorine residual -- once per day from treated water at the water treatment plant; and
- for free and total chlorine residuals -- the same frequency and locations used for bacteriological sampling.

Figure 2.2 Free Chlorine Compliance



A total of 522 municipalities reported 18,832 analyses of free chlorine in 2001/2002. The statistical results were:

Mean:	0.512 mg/L
Median:	0.39 mg/L
High:	9.7 mg/L
Low:	0.01 mg/L
Sum:	9648.29 mg/L
Count:	18,832 samples

During 2001/02 522 out of 544 municipalities reported free chlorine residuals (facility compliance rate of 96.0 per cent). A total of 22,035 residuals were required, therefore the submission rate for testing was 85.5 per cent. More than 87 per cent of the submitted sample results met the minimum requirement for free chlorine.

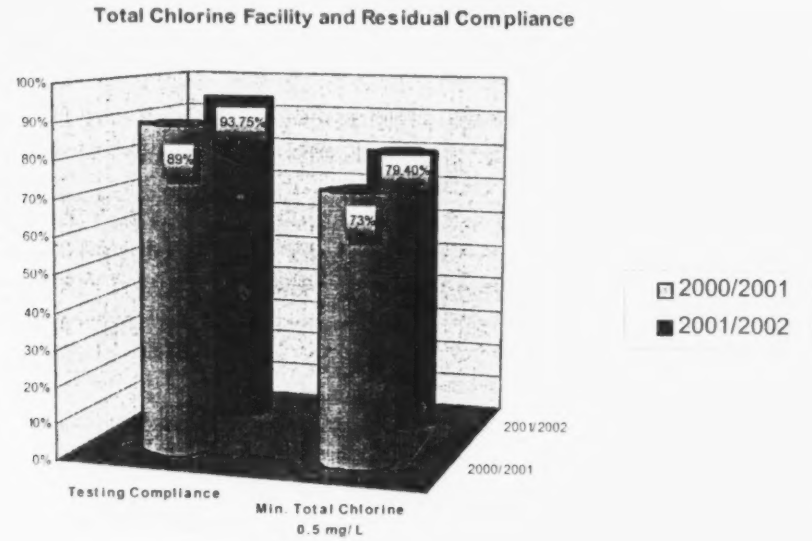
In 2000/2001 a total of 493 municipalities reported 17,398 analyses of free chlorine. The statistical results were:

Mean:	0.496 mg/L
Median:	0.30 mg/L
High:	16.0 mg/L
Low:	0.01 mg/L
Sum:	8,636.02 mg/L
Count:	17,397 samples

During 2000/01 493 out of 544 municipalities reported free chlorine residuals (compliance rate of 88.9 per cent). A total of 20,787 residuals were required, therefore the submission rate for testing was 83.7 per cent. Over 85 per cent of the sample results met the minimum requirement for free chlorine.

About 2,432 samples from 253 municipalities analysed for free chlorine in the 2001/2002 fiscal year contained concentrations less than the regulatory minimum of 0.1 mg/L. Therefore 48.6 per cent of the 522 municipalities that reported free chlorine tests failed to meet the minimum chlorine residual regulation at some time during the fiscal year. A large percentage of the many municipalities that failed to report chlorine tests are likely to have had residuals less than the regulatory minimum. This finding is lower than those reported in 2000/2001, however, 29 more facilities tested and reported free chlorine in 2001/2002 .

Figure 2.3 Total Chlorine Compliance



A total of 510 municipalities reported 18,586 analyses of total chlorine during the 2001/2002 fiscal year. The statistical results were:

Mean:	1.008 mg/L
Median:	0.84 mg/L
High:	8.33 mg/L
Low:	0.01 mg/L
Sum:	18,741.255 mg/L
Count:	18,586 samples

During 2001/02 510 out of 544 municipalities reported total chlorine residuals (compliance rate of 93.75 per cent). A total of 22,035 residuals were required, therefore the submission rate for testing was 84.3 per cent. More than 79.4 per cent of the reported results met the minimum requirement for total chlorine.

A total of 490 municipalities reported 17,082 analyses of total chlorine during the 2000/2001 fiscal year. The statistical results were:

Mean:	0.932 mg/L
Median:	0.75 mg/L
High:	6.9 mg/L
Low:	0.01 mg/L
Sum:	15,916.5 mg/L
Count:	17,082 samples

During 2000/01 490 out of 544 municipalities reported total chlorine residuals (compliance rate of 89 per cent). A total of 20,787 residuals were required, therefore the submission rate for testing was 82.2 per cent. More than 73 per cent of the reported results met the minimum requirement for total chlorine.

A total of 1,182 of the 18,586 samples (6.35 per cent) analysed by 187 facilities in 2001/2002 contained total chlorine concentrations less than the required minimum of 0.50 mg/L and a free chlorine concentration of less than the required minimum of 0.1 mg/L at some point during the fiscal year . The figure of 187 facilities in non-compliance with total chlorine or free chlorine residual regulations accounts for 36.67 per cent of the facilities that actually reported total and free chlorine tests during the fiscal year. Non-compliance is expected to be substantially higher in communities that did not report chlorine residuals.

There are 11 Saskatchewan municipalities (listed below) that did not continuously disinfect their drinking water .

A non-chlorinating system, for the purposes of the following listing (as of March 21, 2002), is a system where chlorine is not added regularly for disinfection purposes. Non-chlorinators would include systems where chlorine is used only for disinfection of repairs, clear wells, etc., but where chlorine is not used regularly. Non-chlorinators would **not** include systems where chlorine is added manually at regular intervals (eg. at least once per day - such systems would be considered as chlorinating). Precautionary Drinking Water Advisories (PDWA's) were in place for the periods which these systems failed to continuously disinfect their drinking water.

Beaubier
Candiac
Gladmar
Herschel
Pathlow
Penzancé
Readlyn
St. Victor
Verwood
Wood Mountain
Zelma

The above list represents a net improvement of 2 municipalities which now continuously chlorinate their water supply since the 2000/2001 report. Others on this listing are taking measures to initiate disinfection during the 2002/03 fiscal year.

2.4 Microbiological Sample Submission Performance

Based on SE's monitoring guidelines for bacteriological sampling(5), and the Ministers Orders issued to the owner of each municipal waterworks, the total submission requirement for bacteriological samples is estimated at 22,035 samples per year(12).

A total of 20,060 regular bacteriological samples were received from licensed waterworks, giving an overall compliance rate of 91.0 per cent. A total of 258 of these were null samples - they could not be counted because:

149	were too old
11	were involved in lab accidents
72	contained interferences
18	were broken in transit.
8	lab results questionable

Total: 258	

Therefore, the net compliance rate for submission of the 19,802 valid samples was 89.9 per cent.

> There were six licensed waterworks that submitted no drinking water samples for bacteriological testing. These systems were: Keeler, Laporte, Pelican Narrows, Readlyn, Stanley Mission, and Verwood (15).

SE has undertaken actions including precautionary drinking water advisories (PDWA) and waterworks inspections to correct this situation.

2.5 **Excursions** (exceeds regulated value)

A repeat sample is required to confirm the initial result when a regular sample is positive (contaminated). When a repeat sample is positive, a system owner is required to submit three special samples to assist in identifying the nature and extent of contamination.

In addition to regular municipal samples, 713 repeat bacteriological samples were received from 298 systems, and 716 special bacteriological samples were submitted by 95 systems.

Regular Sample Excursions

A total of 687 of the 19,802 valid regular samples were positive (3.46 per cent). The distribution of positive samples between total coliform, background and fecal coliform positives is shown in **Figure 2-5.** Distribution of facility per cent positives is shown in **Figure 2-4**

Over 287 regulated waterworks (53 per cent) had samples which failed to meet provincial bacteriological objectives at some time during the year.

Six regulated waterworks had more than 50 per cent of their regular samples test positive; they were: Glenside, Kincaid, Palmer, Parkbeg, Sarnia Beach, and Wood Mountain.

Another 15 Regulated Waterworks had between 25 per cent and 50 per cent of their samples test positive; they were: Brooksby, Erwood, Evesham, Eyebrow, Frobisher, Frontier, Major, Meota, Michel Village, Osage, Pilger, Senlac, Snowden, Spruce Lake and Swan Plain.

A total of 90 communities had greater than 10 per cent of their regular bacteriological samples test positive during the year.

Anytime positive bacteriological samples are reported, SE takes actions such as repeat sampling and the issuance of a PDWA to resolve concerns associated with the bacteriological quality of drinking water.

Figure 2-4 - Facility Distribution of Bacteriological Positives Comparison

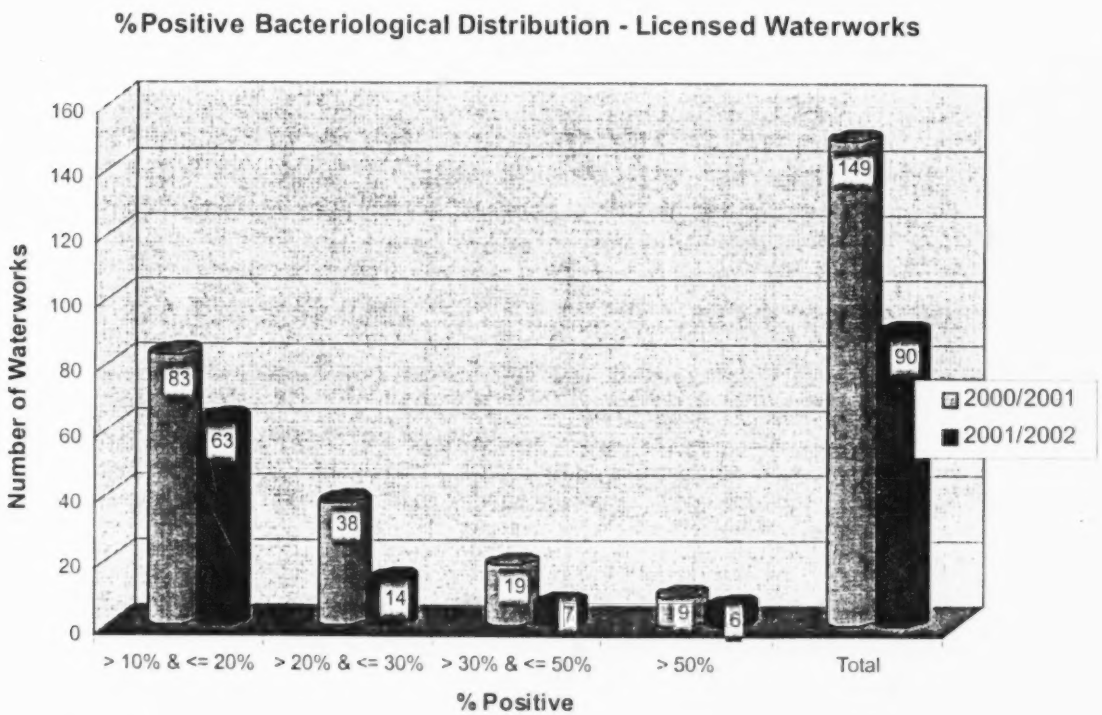
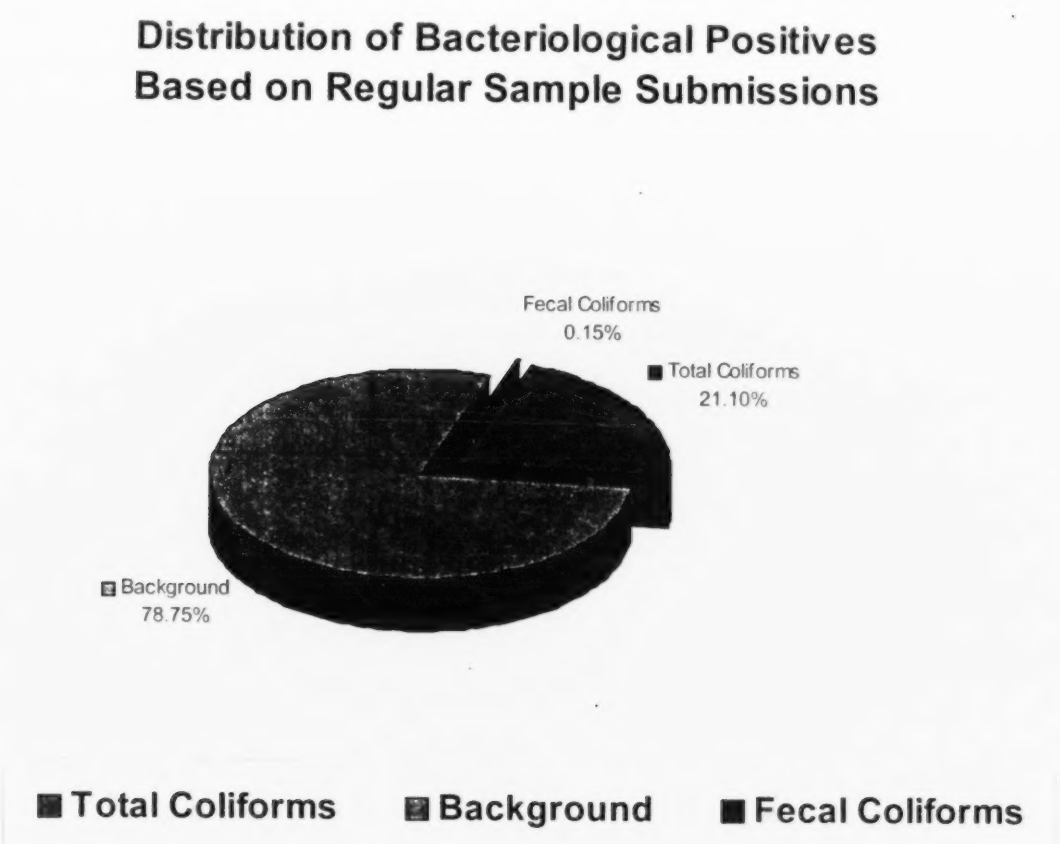


Figure 2-5 - Distribution of Regular Bacteriological Sample Positives



Repeat Bacteriological Samples

The 687 positive regular samples from 289 municipal waterworks should have resulted in the submission of 687 repeat samples. **Only 675 repeat samples were received (98.2 per cent).** Of these 675 repeat samples, 99 were positive (14.4 per cent). It should be noted that 27 municipal waterworks failed to provide 58 repeat samples resulting from bacteriological positives during the 2001/02 fiscal year.

Special Bacteriological Samples

The 99 positive repeat samples should have resulted in the submission of at least 297 specials. **697 specials were received (235 per cent). Of the 697 specials received, 116 were positive (16.6 per cent).**

2.6 Minimum Surface Water Treatment

To ensure that Saskatchewan residents receive safe and palatable drinking water, the province recommends that certain minimum treatment processes be employed in each surface water treatment system. These processes include: coagulation-flocculation, sedimentation, filtration and disinfection. For surface water systems taste/odour control may optionally be employed. Systems with chemically-assisted filtration and disinfection, or cartridge filtration and disinfection are also considered to be employing minimum treatment.

Based on a March 21, 2002 compilation of data, 23 systems did not meet the province's minimum guidelines for surface water treatment; they included: Antler, Benson, Broderick, Brooksby, Congress, Crooked River, Eldersley, Erwood, Fairy Glen, Goodsoil, Gronlid, Leader, Liberty, Mistatim, Osage, Parkbeg, Prairie River, Rama, Ridgedale, Riverhurst, Sunnyside Cottage Owners Association, Trossachs and Uranium City. Corning was removed from the list of communities identified in the previous report period. Increased department presence has resulted in the identification of additional communities which failed to meet SE's surface water treatment requirements and a net increase of seven communities on this listing. PDWA's were in place for the periods which these systems failed to meet minimum treatment requirements.

2.7 Minimum Ground Water Treatment

The minimum recommended treatment for ground water in Saskatchewan is disinfection. Based on a March 21, 2002 compilation of data, approximately 11 systems did not meet the province's minimum guidelines for ground water treatment; they included: Beaubier, Candiac, Gladmar, Herschel, Pathlow, Penzance, Readlyn, St.Victor, Verwood, Wood Mountain, and Zelma. The number of communities on this list decreased from the previous fiscal year, Hubbard, Lake Alma and Pathlow were removed from the list as they now meet minimum treatment requirements. PDWA's were in place for the periods which these systems failed to meet minimum treatment requirements.

3.0 Trihalomethanes (THMs)

3.1 General Introduction

Rationale

Trihalomethanes (THMs) are generated during the water treatment process as a by-product of free chlorine reactions. Significant levels of THMs may occur when the raw water is obtained from a surface water supply. THM's exceeding 100 ug/L (micro grams per Litre) may pose a small (1 in 1,000,000) carcinogenic health risk to consumers who use the drinking water over prolonged periods (70 years). Municipalities monitor THMs to assess health risks and to evaluate the effectiveness of their treatment processes.

For comparison to the THM objective, the winter, spring, summer and fall readings are averaged to calculate an average annual value. THM values illustrate seasonal variability, therefore it is necessary to sample on a seasonal basis.

Drinking Water Quality Objectives

The maximum acceptable concentration of total trihalomethanes (the sum of chloroform, bromodichloromethane, chlorodibromomethane, bromoform) in drinking water is 100 ug/L based on an annual average of seasonal samples. The guideline requirements for THM monitoring[5] are shown in Table 3-1.

Table 3-1 - THM Monitoring Guidelines

Population	Groundwater Source	Surface Water and Blended Source
0 - 100	Nil	1 per 3 months during each Spring, Summer, Fall and Winter
101 - 500	Nil	1 per 3 months during each Spring, Summer, Fall and Winter
501 - 5000	Nil	1 per 3 months during each Spring, Summer, Fall and Winter
5001 - 100,000	Nil	2 per 3 months during each Spring, Summer, Fall and Winter
Greater than 100,000	Nil	2 per 3 months during each Spring, Summer, Fall and Winter

3.2 Sample Submission Performance

A total of 171 surface water treatment and delivery facilities are required to participate in the trihalomethane monitoring program, which should result in 728 samples being submitted each year. The actual number of municipalities that submitted samples was 157 (91.8 per cent). It should be noted that 105 (66.9 per cent) of the 157 municipalities that submitted samples submitted the required seasonal samples. A total of 613 samples (84.2 per cent overall compliance) were submitted by the facilities.

The statistical results are tabulated in Table 3-2.

Table 3-2 - THM Sample Result Distribution

Average Annual THM (ug/L)	Number of Samples	Number of Submitters	THM Range (ug/L)	Number of Samples	Number of Submitters
all	613	157	0-50	105	55
>50	482	123	51-100	132	66
>100	325	82	101-350	253	91
>350	21	6	351-500	12	10
>500	7	2	>500	13	6

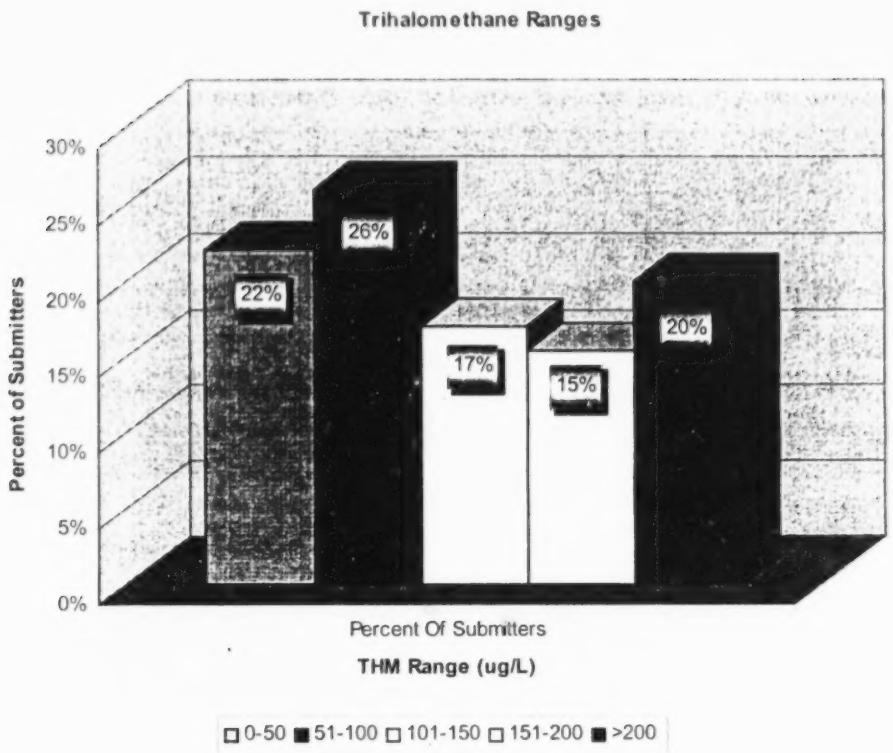
3.3 Excursions

With respect to the annual average of seasonal results, the following is a summary of the number of municipalities that submitted and exceeded the maximum acceptable concentration for trihalomethanes$_{(15)}$.

- 28 municipalities averaged ≤100 ug/L and submitted less than 4 samples.
- 47 municipalities averaged ≤100 ug/L and submitted at least 4 samples.
- 23 municipalities averaged >100 ug/L and submitted less than 4 samples.
- 61 municipalities averaged >100 ug/L and submitted at least 4 samples.

The actual THM distribution, based on annual averages of seasonal samples, is shown in Figure 3-1.

Figure 3-1 - Trihalomethane Ranges



During 2001/02 ninety-eight (98) regulated waterworks (62 per cent) submitted 283 samples for analysis that were over the maximum acceptable concentration for trihalomethanes$_{(15)}$.

During the 2000/2001 fiscal year ninety-three (93) regulated waterworks (66 per cent) submitted 305 samples that were over the maximum acceptable concentration for trihalomethanes$_{(15)}$.

The general increase in the number of trihalomethane samples with results greater than the maximum acceptable concentration during the 2000/2001 and 2001/2002 fiscal years can be attributed to the significant increase in chlorine residuals (post Walkerton reaction) noted for the same period.

4.0 Health and Toxicity Related Chemicals

4.1 General Introduction

Rationale

Health and toxicity related chemicals are a grouping of parameters of health significance to drinking water consumers. These contaminants may be naturally occurring, or they may be introduced into drinking water by human activities.

Iron, manganese, copper, and zinc are included in the general chemical classification. Health and toxicity related samples are collected from the treated water at the water treatment plant.

Drinking Water Quality Objectives

This category comprises inorganic and organic chemical substances that pose a health hazard to individuals if present above certain concentrations in drinking water. For most parameters, the specified Maximum Acceptable Concentrations (MACs) have been derived by assessing the possibility of adverse effects after prolonged exposure.

Table 4-1 - Canadian Drinking Water Quality Guidelines[14]

MAC - Maximum Acceptable Concentration
IMAC - Interim Maximum Acceptable Concentration
AO - Aesthetic Objective

Parameter	MAC	IMAC	AO
	mg/L	mg/L	mg/L
Arsenic		0.025	
Barium	1.0		
Benzene	0.005		
Benzo(a)pyrene	0.00001		
Boron		5.0	
Cadmium	0.005		
Carbon tetrachloride	0.005		
Chromium	0.05		
Cyanide	0.2		
Dichlorobenzene, 1, 2	0.2		0.003
Dichlorobenzene, 1, 4	0.005		0.001
Dichloroethane, 1, 2	0.005		
Dichloroethylene, 1,1	0.014		
Dichloromethane	0.05		
Dichlorophenol, 2, 4	0.9		0.0003
Fluoride [1]	1.5		
Lead	0.01		
Mercury	0.001		
Monochlorobenzene	0.08		0.03
Nitrates as NO_3	45.0		
Nitrilotriacetic acid (NTA)	0.4		
Selenium	0.01		
Tetrachlorophenol, 2,3,4,6	0.1		0.001
Trichloroethylene	0.05		
Trichlorophenol, 2,4,6	0.005		0.002
Trihalomethanes (THM)[2]	0.1		
Uranium	0.02		

(1 - see Section 6 of this report)
(2 - see Section 3 of this report)

Monitoring guidelines for health/toxicity chemicals[15] are shown in Table 4-2.

Table 4-2 - Health/Toxicity Chemical Monitoring Guidelines

Population	Groundwater Source	Surface Water and Blended Source
0 - 100	1 per 2 years	1 per 2 years
101 - 500	1 per 2 years	1 per 2 years
501 - 5000	1 per 2 years	1 per 2 years
5001 - 25,000	Annually	Annually
>25,000	1 per 6 months	1 per 6 months

4.2 Sample Submission Performance

Sample submission requirements for health and toxicity related chemicals were based over a two year (April 1, 2000 to March 31, 2002) period to reflect the monitoring guidelines for some of the facilities which are request to submit one sample every two years.

A total number of 544 facilities were required to sample$_{(12)}$, of which 476 facilities complied (87.5 per cent compliance)$_{(15)}$.

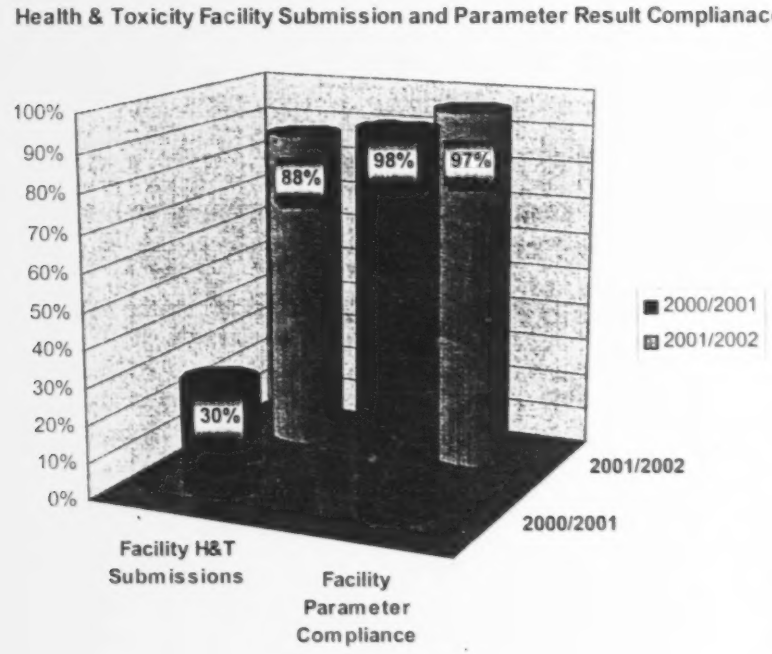
A total of 553 samples were required, and 706 samples were submitted (128 per cent sample compliance).

4.3 Excursions

The total number of facilities that had at least one health and toxicity related chemical excursion was sixteen. There were a total of thirty-one excursions. The following is a list of the parameters and number of excursions at all the facilities:

Arsenic - 2
Boron - 1
Cadmium - 0
Chromium - 2
Copper - 0
Lead - 4
Nitrate - 13
Selenium - 9

Figure 4-1 Health and Toxicity Compliance



During the 2001/2002 fiscal year, eighty-seven per cent of SE licensed waterworks submitted samples; 96.6 per cent of these waterworks met the drinking water quality objectives for H&T related chemicals.

During the 2000/2001 fiscal year, thirty per cent of SE licensed waterworks submitted samples; 95 per cent of these waterworks met the drinking water quality objectives for H&T related chemicals.

5.0 Pesticides

5.1 General Introduction

Rationale

The potential for pesticide detection may vary seasonally. Local use also varies, and there have been relatively few problems with pesticide contamination of drinking water in Saskatchewan. For these reasons, pesticide monitoring is not required in the province, except by communities with populations greater than 5,000.

Drinking Water Quality Objectives

During 2001/02 the provincial objective was no detection of pesticides in drinking water[3]. The MAC's cited in Table 5-1 are those developed by Health Canada[14] for long-term health exposure.

Table 5-1 - Pesticide Guidelines[14]

Parameter	MAC mg/L	IMAC mg/L	AO mg/L
Atrazine		0.005	
Bromoxynil		0.005	
Dicamba	0.12		
Dichlorophenoxyaceticacid - 2,4 (2, 4-D)		0.1	
Diclofop-methyl	0.009		
Pentachlorophenol	0.06		0.03
Picloram		0.19	
Trifluralin		0.045	

It is recognized that this list of pesticides does not include all those available. The list constitutes only a portion of the number of such substances used in Canada, but contains some of the pesticides most commonly used in the Province. Monitoring guidelines for pesticides[5] are outlined in Table 5-2.

Table 5-2 - Pesticide Monitoring Guidelines

Population	Groundwater Source	Surface Water and Blended Source
0 - 100	Nil	Nil
101 - 500	Nil	Nil
501 - 5000	Nil	Nil
5001 - 100,000	1 every 3 years	1 every 2 years
>100,000	Annually	Annually

5.2 Sample Submission Performance

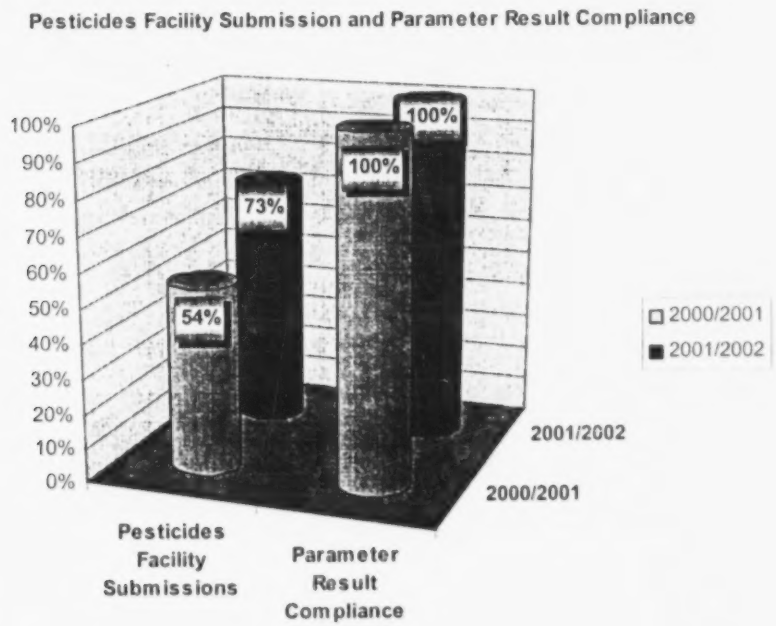
A total number of 11 municipalities are required to sample for pesticides[12]. The monitoring guideline varies between annually, one sample every two years and one sample every three years.

Eight out of the 11 municipalities submitted a sample for pesticide analysis[15].

5.3 Excursions

There were no excursions or detections for pesticides during the 2001-2002 fiscal year[15].

Figure 5-1 Pesticide Compliance



6.0 Fluoride

6.1 General Introduction

Saskatchewan municipalities may decide to artificially add fluoride to their drinking water for the prevention of tooth decay. This decision is often put to the public in the form of a referendum or plebiscite.

Many raw water supplies contain some naturally occurring fluoride. Therefore municipalities need to add differing amounts of fluoride to their drinking water to achieve the optimum range of 0.8 mg/L to 1.2 mg/L. The objective target[3] is 1.0 mg/L. Saskatchewan's MAC for fluoride is 1.5 mg/L.

There are three fluoride chemicals used to add fluoride to drinking water. They are, in order of their estimated volume of usage in the province: hydrofluosilicic acid, sodium silicofluoride and sodium fluoride. If a system owner decides to fluoridate, technical help and advice are available from the Regional Offices to assist in process implementation and operation.

Systems that add fluoride are required to monitor their drinking water for fluoride on a regular basis, as shown in Table 6-1.

Table 6-1 - Fluoridation Monitoring Guidelines[5]

POPULATION	GROUNDWATER SOURCE	SURFACE WATER AND BLENDED SOURCE
0 - 100	1 per 4 weeks	1 per 4 weeks
101 - 500	1 per 4 weeks	1 per 4 weeks
501 - 5,000	1 per week	1 per week
5,001 - 100,000	1 per week	1 per week
Greater than 100,000	1 per week	1 per week

There are presently 60 licensed works that artificially fluoridate their drinking water or have naturally occurring fluoride (*) in Saskatchewan. They are listed as follows:

Annaheim, Assiniboia, Balgonie, Big River, Bruno, Canora, Carnduff, Dinsmore, Domremy, Estevan, Eston, Ferland(*), Foam Lake, Frontier(*), Goodsoil, Gull Lake, Hoey, Humboldt, Indian Head, Kamsack, Kerrobert(*), Kindersley, Lafleche, Langenburg, Langham ,La Loche(*), Lake Lenore, La Ronge, Lashburn, Luseland, Mankota(*), Marysburg, Meadow Lake, Melfort, Melville, Moose Jaw, Moosomin, Mortlach, Muenster, Naicam, Outlook, Preeceville, Prince Albert, Rosetown, Rosthern, Rouleau, Rush Lake(*), Saskatoon, SPC Coronach(*), Star City, St. Isidore de Bellevue, Swift Current, Tisdale, Turtleford, Wadena, Wakaw, Watson, Weyburn, Whitewood, and Wynyard.

* Naturally high fluoride

This equates to a total Saskatchewan population[16] of 370,466 (37.84 per cent of the total of 978,933 based on 2001 census) receiving fluoridated drinking water.

6.2 Fluoride Excursions

Three communities have fluoride naturally present in their water supplies at concentrations exceeding the MAC of 1.5 mg/L in 2000/2001. They are:

Ferland, Frontier and Rush Lake

Results from all systems that artificially fluoridate or that have high naturally occurring fluoride are monitored regularly by SE.

A total of 3,069 samples were submitted by 483 systems for fluoride analysis. **Only nine municipalities had one or more result which exceeded the MAC of 1.5 mg/L.** Of these nine municipalities, three are known to have high natural fluoride, and six artificially fluoridate their water. Communities with high natural fluoride have been notified, and Saskatchewan Health has been advised.

Fluoride concentration statistics from the municipalities were as follows:

Mean:	0.681 mg/L
Median:	0.7 mg/L
High:	3.38 mg/L
Low:	0.04 mg/L
Sum:	2090.27 mg/L
Count:	3,069 samples

Note: These data include routine submission data from fluoridating systems, as well as routine monitoring done by non-fluoridating systems with the General Chemical samples they submit in accordance with their Ministers Orders.

7.0 Total Dissolved Solids

7.1 General Introduction

The guideline for total dissolved solids (TDS) relates to taste and palatability rather than to detrimental health effects on humans. TDS concentrations of 500 mg/L or less have been designated as a Canadian objective[14] level for drinking water, provided that none of the individual constituents exceed their specific guidelines. If the TDS concentration exceeds 2000 mg/L laxative effects have been observed in drinking water consumers. Saskatchewan has designated the TDS objective of 1,500 mg/L due to the relatively elevated mineral concentrations of provincial water supplies[3].

Rationale

The composition and concentration of general chemicals identify a water's chemical character. This will vary among supply sources. A groundwater supply generally will have less variability than surface water, which tends to vary at least on a seasonal basis. Monitoring is done to track trends, to make treatment process decisions, and to provide information for environmental impact evaluation. Iron and manganese are two significant aesthetic issues for Saskatchewan municipalities, many of whom treat their drinking water to remove these metals.

Drinking Water Quality Objective

Saskatchewan's aesthetic objective for total dissolved solids in drinking water is 1,500 mg/L[3]. Monitoring guidelines[5] for TDS are shown in Table 7-1.

Table 7-1 - TDS Monitoring Guidelines

Population	Groundwater Source	Surface Water and Blended Source
0 - 100	1 per 2 years	1 per 3 months every 2 years
101 - 500	1 per 2 years	1 per 3 months every 2 years
501 - 5000	1 per 2 years	1 per 3 months every 2 years
5001 - 100,000	1 per 6 months	1 per 3 months
>100,000	1 per 6 months	1 per 3 months

Table 7-2 outlines Saskatchewan's General Chemical parameters.

Table 7-2 - Objectives for General Chemical Parameters[3]

Parameter	AO (mg/L)
Alkalinity (as $CaCO_3$)	500
Chloride	250
Copper	1.0
Hardness (as $CaCO_3$)	800
Iron	0.3
Magnesium	200
Manganese	0.05
Sodium (1)	300
Sulphate (2)	500
Sulphide (as H_2S)	0.05
Total Dissolved Solids	1500
Zinc	5

This category comprises certain chemical substances that could, if present in excessive amounts, interfere with the intended domestic uses of the finished water. These chemicals may be aesthetically objectionable, interfere with water treatment processes and distribution, or stain fixtures and plumbing. Aesthetic objectives have therefore been established for these substances.

1. It is recommended that sodium be included in routine monitoring programs since levels may be of interest to authorities who wish to prescribe sodium-restricted diets for their patients.

2. There may be a laxative effect in some individuals when sulphate levels exceed 500 mg/L.

7.2 Sample Submission Performance

Sample submission compliance for total dissolved solids was based on general chemical submission over a two year period (April 1, 2000 to March 31, 2002) to reflect the monitoring guidelines for some facilities which are required to submit one or four samples every two years.

A total number of 544 facilities were required to sample, of which 288 facilities complied (53 per cent compliance)[15].

A total of 1398 samples were required and 447 samples were submitted (32 per cent compliance).

The statistical results[15] are tabulated in Table 7-3, and shown graphically in Figure 7-1.
A comparison to the 2000/2001 report on TDS Compliance to the aesthetic objective is shown graphically in Figure 7-2.

Table 7-3 - TDS Ranges (2000-2002)

TDS levels (mg/L)	0-500	501-1000	1001-1500	1501-2000	2001-2500	2501-3000	>3000
FACILITIES	61	83	67	54	33	6	5
SAMPLES	121	130	78	67	38	6	7

Figure 7-1 - TDS Distribution

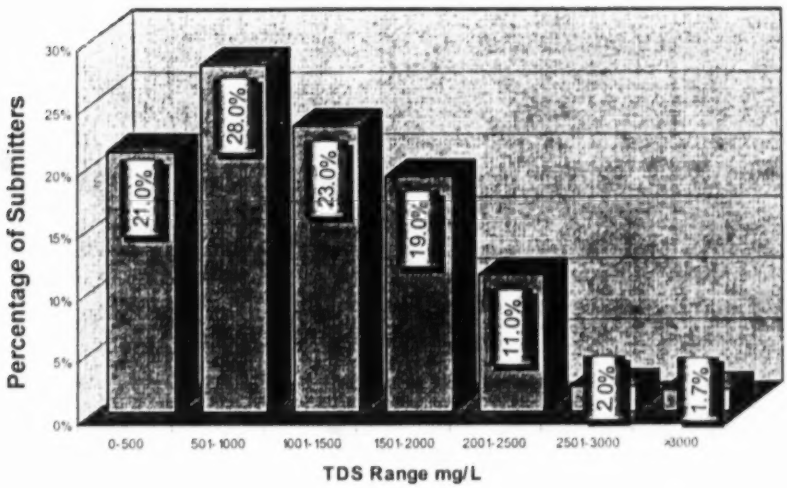
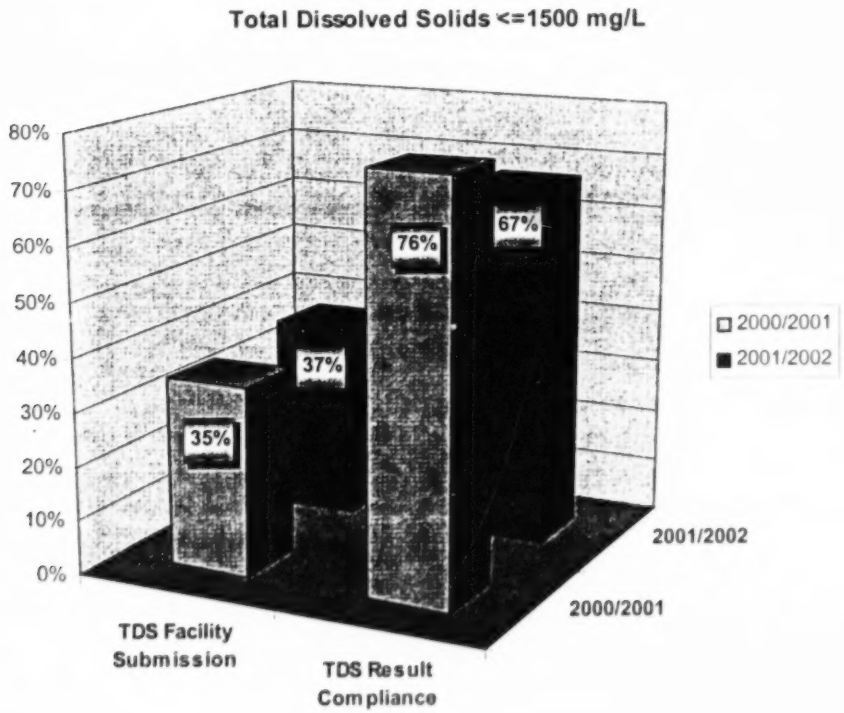


Figure 7-2 - TDS Compliance Comparison



7.3 Excursions

The total number of facilities that exceeded the aesthetic objective of 1,500 mg/L for total dissolved solids was 94 or 33 per cent of the facilities submitting. There were 118 samples or 26 per cent of the samples submitted that exceeded the aesthetic objective.

8.0 System Operators

8.1 General Introduction

Rationale for Operator Certification

Water/wastewater system operators, who play a critical role in producing safe drinking water and preventing environmental pollution, are finding their jobs becoming more responsible, more complex and subject to a great deal of technological change. Increasing public awareness and knowledge of drinking water safety, and wastewater pollution issues have placed much higher expectations for change on municipalities and the operation of their water/wastewater systems. Ensuring that the training and qualifications of these operators will meet the challenge of providing safe drinking water and environmental protection is of prime concern to the public, the system managers and to regulators[17][18].

The PUBLIC needs trained and certified operators to provide safe drinking water and to protect itself and the environment from pollution.

SYSTEM MANAGERS need certified operators, because certification is an indication of an operator's knowledge, skills and competency to operate complex treatment and testing equipment. Managers need to know that operators can safeguard a community's investment in the water utility and in its investment in the on-going budget.

REGULATORS who establish and monitor water quality standards which facilities must meet need trained and certified operators to ensure that these parameters are being met in a consistent manner.

Studies have consistently found that the mandatory certification of operators along with a comprehensive training program is necessary to ensure that the required education, skill training and examination of knowledge occurs, in order to achieve the operational standards needed within the industry.

Legislation and Mandate for Mandatory Certification Program

The *Environmental Management and Protection Act (1990)*[2] states in article 38 (f) that "The Lieutenant Governor in Council may make regulations respecting the training and qualification of operators of industrial effluent works, waterworks and sewage works." Articles 38 (g) -(i) state that the Lieutenant Governor in Council may make regulations pertaining to the establishment of a certification board, and they explain the powers and duties of the board and the terms and conditions whereby board members are appointed.

On July 14, 2000, *The Water Pollution Control and Waterworks Amendment Regulations, 2000* (WPCWAR) were enacted pursuant to section 38(1) of *The Environmental Management and Protection Act (1990).* These regulations established an Operator Certification Board and empowered the Board to administer the Operator Certification Program.

Within five (5) years of the date when the WPCWAR came into force, all municipal water and wastewater treatment facilities in the Province of Saskatchewan are required to have an appropriately certified operator to supervise the operation and maintenance of these works. The same requirement also applies to non-municipal works, which are privately owned water and wastewater works with an average flow of potable water or wastewater, in three consecutive months having the greatest flow in a year, exceeding 18 cubic metres per 24-hour period.

8.2 Compliance With the Mandatory Certification Program

Number of Operators Participating

At the end of fiscal year 2001/2002 there were approximately 1,650 municipal operators on the operator database[12]. Of these, 302 operators were certified in the **mandatory** operator certification program; this is a participation rate of 18.3 per cent, which is significant considering the new requirements of certification examinations, application fees and renewal fees.

Depending on the size of a community and particular duties, an operator could be involved in any or all of the following work categories, namely: water treatment, water distribution, and, not shown in Table 8-1, wastewater treatment and wastewater collection[7]. An operator could be certified in one, several or all of these categories, depending on the area(s) in which the operator is working. Additionally, the operator could be certified at any one of four classes or levels within each of the categories, depending on formal education, work experience and system size and complexity, ranging from class 1 (small system) to class 4 (large and complex system).

Since this report only deals with drinking water, i.e. water treatment and water distribution, Table 8-1 only compares the number of mandatory certified operators in the four classes or levels of certification in water treatment and water distribution in the two years following the inception of the new program.

Table 8-1 - Distribution of Mandatory Certified Operators by Fiscal Years[12]

	Water Treatment		Water Distribution	
	FY2000/2001	**FY 2001/2002**	**FY2000/2001**	**FY 2001/2002**
SWS[1]	1	31	1	31
Class 1	18	96	15	114
Class 2	6	63	2	55
Class 3	7	26	1	5
Class 4	4	6	-	-
Totals	36	222	19	205

Note #1 SWS means Small Water System. This is defined as a Class-1 ground water treatment plant and/or Class-1 ground water distribution system serving a population of 500 or fewer. The only variance from a Class-1 system is the certification criteria.

Historically, the participation of operators in the certification program has been most prevalent in the areas of water treatment and wastewater treatment (not shown), and less so in the areas of water distribution and wastewater collection (not shown). The largest number of operators that are certified are in the water treatment class 1 and class 2 categories, because operators at these levels are generally employed in the many small communities. They usually turn to SE for technical advice and turn to SWWA and SIAST for operator training. While participating in this manner, operators and the communities that employ them are informed about the certification program and of the benefits of training and certification. Operators from larger facilities (class 3 or class 4) have historically not participated in the operator training program to the same extent, since they have in-house technical and engineering staff that are able to provide this service. As well, operators from larger facilities have not participated in the operator certification program to a great extent until the program became mandatory. On the other hand, operational staff from some of the larger facilities have instructed at operational skill training workshops.

Participation of operators in the certification areas of water distribution and (not shown) wastewater collection has been only at the class 1 and class 2 levels, because at these levels, the persons are typically also the water treatment plant operators. Water distribution and wastewater collection system staff in larger communities are in a public works department and generally have not had regular contact with SE.

8.3 Mandatory Operator Certification

In the two years since July 14, 2000, when the WPCWAR was enacted, 302 operators have become certified in the new Mandatory Certification Program by criteria of education, facility work experience and examination.

By 2005 all waterworks licenced by Saskatchewan Environment will require to have at least one operator certified to operate the class of facility being operated. Based on the data available at the end of fiscal year 2001/2002, 145 facilities have at least one such operator which represents a 26.7% achievement towards the 2005 target for municipal waterworks.

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